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The National Hospital Discharge Register Data on Lower Limb Amputations

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Aim. *To study if data on lower limb amputations and vascular operations in the National Hospital Discharge Register can be used for comparison of diabetes care between hospital districts.*
Methods. *We identified diabetic persons from the National Hospital Discharge Register (1988–2002), the National Social Security Institute (since 1964) and pharmacies (since 1994). A search for lower limb amputations and vascular operations was made through the Hospital Discharge Register. An analysis of the correlation of the age and gender adjusted incidence of first major amputations and the age and gender adjusted incidence of first vascular operations for diabetics was made between 14 hospitals districts with the largest diabetic population.*
Results. *A total of 308,447 diabetics were identified. There were 11,070 diabetics who had a lower extremity amputation and 9530 diabetics who had a vascular operation in Finland in 1988–2002. The annual number of first amputations decreased from 924 to 387 per 100,000 diabetics during the study period. There were up to three-fold differences in age and gender adjusted indexed numbers of first amputations between different hospital districts during the last follow-up period from year 2000 to 2002. There was a clear inverse correlation between the incidence of first major amputations and first vascular operations and particularly between incidence of first major amputations and infrapopliteal reconstructions.*
Conclusion. *The incidence of major amputation is declining in the diabetic population. This positive development can be explained by more active vascular operative treatment. Regional differences are wider than acceptable.*

Keywords: Diabetic foot; Register data; Amputations; Vascular surgery; Quality control; Audit.

Introduction

Diabetics are 20 times more vulnerable to lower limb amputation than non-diabetics.[1] Forty to sixty percent of all lower limb amputations are performed in diabetics.[2] Vascular surgery has been associated with a reduction in major lower limb amputation.[3–5] Amputations are the clearest endpoint in assessing the efficacy of diabetic foot prevention and treatment regionally.

The aim of the study was to test if there are regional differences in the number and pattern of amputations during a 15-year period. We also wanted to test if the regional differences in the incidence of major amputations was related to vascular surgery activity.

Material and Methods

Finland has a comprehensive national discharge register over all hospital based episodes of care since 1970. We started by identifying diabetic persons from the National Hospital Discharge Register in 1988–2002. To this list of persons, who had had hospital care with the diagnosis of diabetes, we added all individuals from the register of the National Social Security Institute who received their anti-diabetic drugs reimbursed during any period since 1964 and all persons to whom anti-diabetic drugs have been delivered from pharmacies since 1994.

The Hospital Discharge Register does not necessarily reveal that a patient has diabetes, if diabetes is not the reason for hospitalization. This is why we at first had to identify those persons in Finland, who have diabetes, as described above. After that it was possible to look at the amputations of lower limbs in all persons with diabetes during 1988–2002 by following the episodes of care in hospitals by using the Hospital

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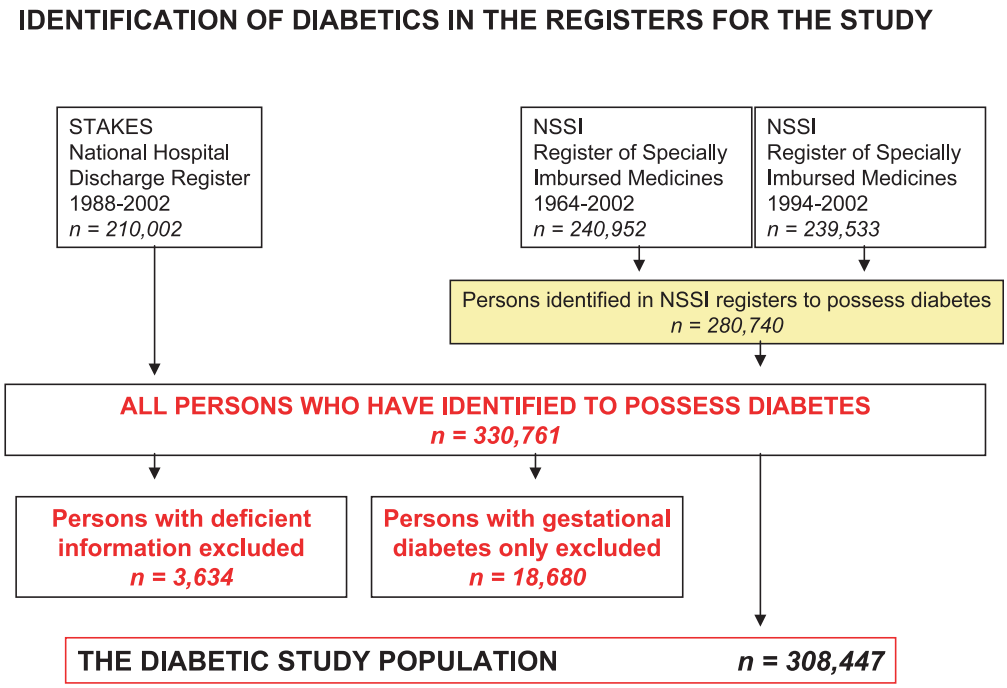

Fig. 1. Data retrieval: identification of the diabetics in the registers for the study.

Discharge Register and the Surgical Codes† of Nordic Medico-Statistical Committee.[6]

The incidence of amputations was compared between the hospital districts by standardizing the regional diabetic populations with age and gender. Many patients had several amputations done during this period. We chose to analyse the incidence of the first amputation of each diabetic person as the best marker of the ability of diabetic service to prevent amputations. Because of the small number of amputations per year in the smaller hospital districts, we clustered the numbers into 3-year intervals. The regional differences were described by indexing total number of first amputations in the country during the period of 1994–1996 as 100.

The relationship of minor and major amputations was counted for every year for each hospital district and the whole country.

The incidence of lower limbs vascular operations was then compared with the incidence of major amputations during the last 6 years (1997–2002) in the 14 hospital districts with the highest number of persons with diabetes. Endovascular procedures were not included because they were not properly registered and their use for critical ischaemia was scarce. Age and gender standardisation was made before the analysis. The statistical analyses were performed with SAS using Spearman's rank correlation test.

† The surgical codes of Nordic Medico-Statistical Committee (NOMESCO) were used for identification of operations. Minor amputations were identified by surgical codes NHQ30 and NHQ40, major amputations by NGQ10, NGQ20, NHQ10, NHQ20, vascular operations by codes PDE, PDF, PDH, PDU, PEE, PEF, PEH, PEN, PEQ, PEU, PFE, PFH, PFN, PFQ, PFU, PGH or by their previous equivalents of Scandinavian short list of surgical operations.

Results

We were able to identify 308,447 diabetics in the registers (Fig. 1).

There were 11,070 diabetics who had had one or more lower limb amputations performed during the period of 1988–2002. The number of first amputations decreased from 924 to 387 per 100,000 diabetics from 1988 to 2002 in Finland. The pattern of decline was similar in women and men, although faster in women (Fig. 2). Age and gender adjusted indexed number of first amputations (proportioned to the diabetic population) varied from 35–106 during the last follow-up period 2000–2002, when the whole country was marked with 100 for the years 1994–1996 (Table 1).

Big differences between hospital districts could be seen during the study period. The age and gender adjusted number of lower limb first amputation shows a decline in all districts, except the smallest one. Indexed number of first lower limb amputations decreased from 154 to 75 nationwide (Table 1). The number of first minor amputations increased from 271

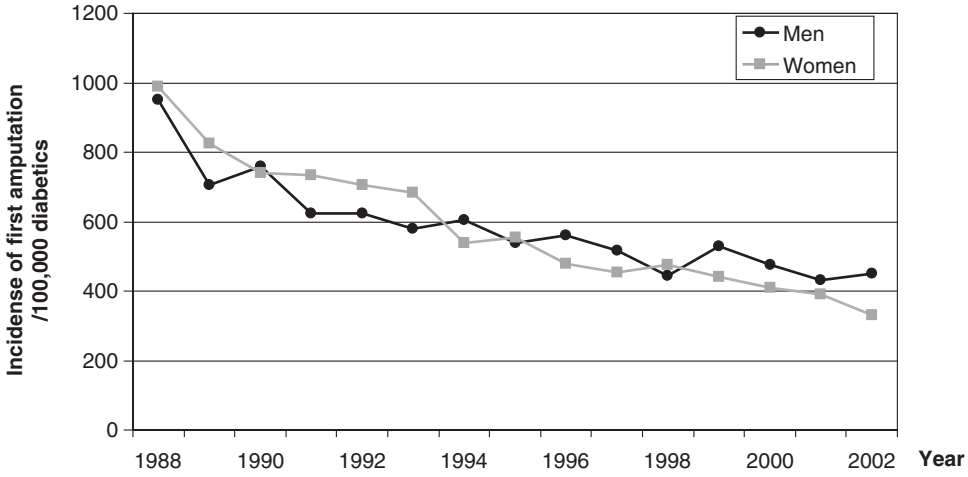

Fig. 2. The number of first amputations of diabetics in Finland 1988–2002 (per 100,000 diabetics).

to 419 and the number of major amputations decreased from 657 to 448 (Table 2).

The subgroup of 14 hospitals during years 1997–2002 consisted of 146,256 diabetics in 1997 and 184,721 diabetics in 2002. A total of 2842 first major amputations and 1908 infrapopliteal reconstructions were identified within the subgroup. Comparing the correlation of age and gender adjusted incidence of first vascular operations with age and gender adjusted incidence of first major amputations a strong inverse correlation ($r = -0.771$, $p < 0.001$) was encountered. The correlation is even stronger with infrapopliteal vascular operations $r = -0.793$, $p < 0.0001$.

Discussion

The validity of the National Discharge Register data has been recently assessed.[7] The accuracy of diagnosis indicating the reason for care proved good when the Finnish National Hospital Discharge Register was compared with the population-based myocardial infarction register, FINMONICA/FINAMI. In their study Kantonen *et al.* found similarly that only in two out of 15 Finnish vascular centres the local surgical data recorded in the national vascular registry, FINNVASC was more complete than the National Discharge Register data.[8,9] These studies support our

Table 1. Indexed (proportioned to the diabetic population, period 1994–1996 index 100) numbers of first amputations in lower limbs in the different hospital districts

Hospital district	1988–1990	1991–1993	1994–1996	1997–1999	2000–2002
Uusimaa	140	114	102	90	69
Helsinki	135	111	89	73	72
Varsinais-Suomi	193	149	105	102	82
Satakunta	181	162	125	93	67
Kanta-Häme	179	109	100	81	58
Pirkanmaa	141	124	90	92	71
Päijät-Häme	148	120	109	79	92
Kymenlaakso	142	109	93	106	62
Etelä-Karjala	161	71	82	63	66
Etelä-Savo	182	117	99	98	106
Itä-Savo	244	166	155	123	88
Pohjois-Karjala	150	126	108	87	73
Pohjois-Savo	195	155	143	89	99
Keski-Suomi	169	137	86	87	90
Etelä-Pohjanmaa	123	124	95	90	63
Vaasa	103	80	46	60	56
Keski-Pohjanmaa	119	120	92	91	67
Pohjois-Pohjanmaa	105	108	96	86	83
Kainuu	154	107	129	77	54
Länsi-Pohja	232	169	114	57	84
Lappi	142	102	86	62	35
Ahvenanmaa	65	137	29	44	106
Finland	154	123	100	87	75

Table 2. Number of minor and major amputations and their ratio in Finland 1988–2002

Year	First minor	First major	Ratio
1988	271	657	0.41
1989	261	597	0.44
1990	268	604	0.44
1991	259	581	0.45
1992	298	579	0.51
1993	332	546	0.61
1994	314	520	0.60
1995	315	528	0.60
1996	359	496	0.72
1997	353	464	0.76
1998	353	476	0.74
1999	422	498	0.85
2000	401	459	0.87
2001	411	453	0.91
2002	419	448	0.94

belief that a comparison of the incidence of first amputations of diabetics could be performed with reasonable accuracy between the hospital districts using data from the National Discharge Register data.

While the number of diabetic patients is steadily growing in Finland, the portion of them being amputated is steadily decreasing. This can be interpreted to illustrate mainly the improved efficacy of the seamless chain of services for diabetics with foot problems. The concurrent decrease in the incidence of major amputations also previously observed in overall amputation rates in Southern Finland,[3] contradicts the findings of earlier epidemiological studies.[10]

According to the present study the positive development of decreasing the number of amputated persons has taken place at varying speeds in different hospitals districts. This can be explained by the attitudes and skills with which the changes of care are driven. A strong inverse correlation in Finland between the number of vascular operations and the number of major amputations for diabetics suggests an important role of vascular surgery in preventing major amputations. However, it is impossible to distinguish that from the role of other preventive measures.

There was a three-fold difference in the indices of first amputations between hospital districts. Such differences should not exist as they illustrate the poor structure of foot care organisation. There are, however, also differences in the availability of vascular services in different regions and even variation within some of the districts during the 15-year follow-up period. The role of endovascular procedures for preventing amputations was not evaluated in the present study. Recent Finnish studies showed that the use of endovascular interventions for the treatment of critical leg ischaemia has been very sparse in Finland until recently[11,12] with one exception.[13,14] The new law in 2005 of guarantee of care should result in diminishing differences in the amount of services that depend on the lack of personnel.[15]

The present data should be used for planning the health care services for diabetics in order to prevent amputations. Each hospital district has to analyse their own figures, comparing them with national data and then decide, if there is a need for quality development. All elements of the prevention chain are needed to decrease the manifestation of diabetic foot lesions and thus the number of amputations.[16,17] The present results emphasise the role of vascular surgery in preventing major amputations. National registry data should be used to develop vascular services towards uniform standards.

References

1 Van Houtum W, Lavery L, Harkless L. The impact of diabetes-related lower-extremity amputations in the Netherlands. *J Diabetes Complications* 1996;**10**(6):325–330.
2 Apelqvist J, Larsson J. What is the most effective way to reduce incidence of amputation in the diabetic foot? *Diabetes Metab Res Rev* 2000;**16**(Suppl 1):S75–S83.
3 Eskelinen E, Lepantalo M, Hietala EM, Sell H, Kauppila L, Maenpaa I *et al*. Lower limb amputations in Southern Finland in 2000 and trends up to 2001. *Eur J Vasc Endovasc Surg* 2004;**27**:193–200.
4 Eskelinen E, Luther M, Eskelinen A, Lepäntalo M. Infrapopliteal bypass reduces amputation incidence in elderly patients: a population-based study. *Eur J Vasc Endovasc Surg* 2003;**26**:65–68.
5 Luther M, Kantonen I, Lepantalo M, Salenius J, Group KY. Arterial intervention and reduction in amputation for chronic critical leg ischaemia. *Br J Surg* 2002;**87**:454–458.
6 Nordic Medico-Statistical Committee (Nomesco). *Surgical codes,* 1996 [Copenhagen, ISBN 87-89702-13-1].
7 Pajunen P, Koukkunen H, Ketonen M, Jerkkola T, Immonen-Raiha P *et al*. The validity of the Finnish hospital discharge register and causes of death register data on coronary heart disease. *Eur J Cardiovasc Prev Rehabil* 2005;**12**(2):132–137.
8 Kantonen I, Lepäntalo M, Salenius J-P, Forström E, Hakkarainen T, Huusaari H *et al*. Auditing a nationwide vascular registry—the 4-year Finnvasc experience. *Eur J Vasc Endovasc Surg* 1997;**14**:468–474.
9 Luther M, Lepäntalo M, Albäck A, Mätzke S. Amputations as a measure of vascular surgical results. *Br J Surg* 1996;**83**:241–244.
10 Pohjolainen T, Alaranta H. Lower limb amputations in Southern Finland 1984–1985. *Prosthet Orthot Int* 1988;**12**:9–18.
11 Mätzke S. *Identification and outcome of critical leg ischaemia*. Helsinki, Helsinki University, 2004 [ISBN 952-91-7890-5].
12 Eskelinen E, Albäck A, Roth W-D, Lappalainen K, Keto P, Railo M *et al*. Infrainguinal percutaneous transluminal angioplasty for limb salvage: a retrospective analysis in a single center. *Acta Radiol* 2005;**46**(2):155–162.
13 Jamsen T, Manninen H, Tulla H, Matsi P. The final outcome of primary infrainguinal percutaneous transluminal angioplasty in 100 consecutive patients with chronic critical limb ischemia. *J Vasc Interv Radiol* 2002;**13**:455–463.
14 Matsi P. Percutaneous transluminal angioplasty in critical limb ischaemia. *Ann Chir Gynaecol* 1995;**84**:359–362.

15 Ministry of Social Affairs and Health. Uniform criteria for access to non-emergency treatment. Handbook of the Ministry of Social Affairs and Health, 2005; 5:1–240 [in Finnish].
16 Rith-Najarian S, Branchaud C, Beaulieu O, Gohdes D, Simonson G, Mazze R. Reducing lower-extremity amputations due to diabetes: application of the staged diabetes management approach in a primary care settting. *J Fam Pract* 1998;**47**:127–132.
17 Simonsen GD, Rith-Najarian S, Braunchaud C, Beaulieu O, Valvatine G, Mazze RS. Prevention of diabetes related amputation in an American Indian community using staged diabetes management. *Diabetes Res Clin Pr* 2000; **50**(Suppl 1):408.

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